The method used to compute flash flood guidance is the reverse of the normal use of a rainfall-runoff model in which runoff is desired. For flash flood guidance purposes an amount of rain is needed that produces a given amount of runoff. The equation for flash flood guidance calculations can be written as follows:

$$R_t = FFG*I + f(FFG)*(1-I) \quad (1)$$

where FFG is the flash flood guidance in inches
I is the percent impervious area
R_t is the total runoff in inches

In some of the rainfall-runoff models (e.g. Sacramento Model) impervious area is integrated within the model. In other cases, such as with the event API models, impervious area is not a model parameter. In order to apply these API models to urban areas for computing FFG, the impervious area needs to be specified as an additional parameter.

Regardless of the types of guidance, two values are required to compute flash flood guidance for a desired area:

- the runoff required to initiate flooding
- the current soil moisture conditions

Adjustment for High Flow

The computation of total runoff R_t above assumes the stream has very little flow compared with the flow at flood stage. At high flows for headwaters and other gaged locations, the additional runoff needed to fill the channel to flood stage is called threshold runoff R_h ($R_h \leq R_t$). R_h is substituted for R_t in Eq. (1) and is computed by the following equation:

$$R_h = \frac{Q_f - Q_i}{q_{pR}} \quad (2)$$

where R_h is the threshold runoff in inches at a high flow
Q_f is the flow in cubic feet per second (cfs) at flood stage
Q_i is the flow in cfs at a time in the future
q_{pR} is the unitgraph peak in cfs

Q_i in Eq. (2) is set to zero if the adjustment for high base flow is not desired.

For small streams where areal FFG is desired, the total threshold runoff R_t has been determined from channel hydraulics as part of the development effort. To adjust the small stream for high flow, a ratio (C) is applied; i.e.,

$$R_h = R_t(1 - C) \quad (3)$$

where R_h is the threshold runoff in inches with streams at high flows
Rt is the threshold runoff at low or no flow
C is the ratio of flow at a time in the future divided by the bankfull flow

For headwaters and small streams Eq. (1) is solved for FFG by an iterative

process that results in producing the threshold runoff R_t. At a high flow R_h is substituted for R_t in Eq. (1). Then, for headwaters R_h is determined by Eq. (2) and for small streams, Eq. (3).

Adjustment for Intensity

To adjust flash flood guidance for intensity, two options are available:

- adjust runoff, or
- assign a specific value for flash flood guidance independent of soil moisture conditions

Eq. (4) adjusts threshold runoff R_h by intensity factor INTEN:

$$R_h = R_h * INTEN \quad \textbf{(4)}$$

For the second option:

$$FFG = INTEN \quad \textbf{(5)}$$

As more experience is gained with intensity adjustments these initial, empirical algorithms should be replaced.